SCIENCE

NEW YORK, FEBRUARY 23, 1894.

SOME RECENT WORK ON CLAYS.[1]

BY G. PERRY GRIMSLEY, BALTIMORE, MD.

THE seventh volume of the Ohio Geological Survey, under the direction of Prof. Edw. Orton, which has just appeared, contains an extended and interesting chapter on the clay deposits and workings in that State. The work is primarily intended for the assistance of those actively engaged in this work, and many suggestions are given which will prove of great value; but here also will be found the only complete account of the process of manufacture of city paving materials.

Ten years have passed since the last published work on Ohio clays; in this interval there has been great expansion in the industry, and new features have been introduced. At the present time there are over twenty-five distinct lines of clay manufacture, and in most Ohio leads. In the sewer-pipe industry it stands foremost in amount of ware and in possession of three of the largest factories in the world.

Coal has always been regarded as Ohio's great source of mineral wealth, but where this is removed clay deposits are found which are greater sources of wealth than the original coal. Thus the Ohio coal measures are now becoming the clay measures.

The best clay must be free from calcium, iron and alkali bases, for if these be present they will act as fluxes, so destroying the clay as a refractory material. Since clay originates from minerals containing these elements, it is rare to find this high grade clay, and, when found, the deposits are most valuable.

There is no true scientific classification of clays, but they are popularly divided into clays and shales; the latter originated in deeper water and very often show no plasticity. A high grade clay is composed of kaolin and silica, while the poorer grades in addition have the fluxing elements.

It is found that nearly every coal seam is underlaid by a clay, locally called fire clay. In most cases it is everything but a fire clay and is used only in potteries.

Most of the true fire clays of Ohio belong to the non-plastic type. In this clay small microscopic bundles of rods are found, indicating incipient crystallization; it is thought the peculiar property of hard fire clay depends on this property, since there is no chemical difference between such a clay and a plastic one.

The lowest clays worked in the State are found at the base of the Upper Silurian, but they are only of local interest. The first important series to be worked is the great mass of Devonian black and blue shales at Columbus used in the extensive sewer pipe industry. The best clay in quality is found in the sub-Carboniferous Sciotoville clay used for fire brick.

The important clay industries of the State are based almost wholly on the coal measure clays and shales. Under and over the coal occur clay and shales.

The first of the Ohio coals has a roof of shales, which forms the basis of one of the largest sewer-pipe and roofing tile works in this country, located at Akron.

The Mercer clays, below the Mercer coals, are used in the manufacture of terra cotta and ornamental brick, while the Kittanning series support a second fire brick industry at Mineral Point.

In the Freeport horizon occur the clays and shales which are used so extensively in central Ohio for the manufacture of paving brick.

It would be interesting to follow out the development in the different lines, if space permitted, but only the new enterprise introduced in the last few years into this country will be reviewed. This whole subject has been most carefully investigated and described by Mr. Edw. Orton, jr., in this report.

Ten years ago shales were regarded as so much waste in the clay workings; now they are found to be of great value.

The difference between paving brick and common brick rests on the fact that the elements of the former have reached a state of fusion, and so are chemically united; while in the latter it is more the physical union of adhesion. The true test is absorption, which would be nothing in a perfect paving brick.

The clay must conform to certain conditions in order to yield a good paving brick. It must combine refractoriness with fusibility and must be sufficiently plastic to be easily worked. The amount of iron present determines the color of the ware and smoothness of surface.

An average of a large number of analyses shows the composition of a good paving brick to be 84.78 per cent clay and sand, 13.22 per cent fluxes. High heat is not required and if present ruins the product.

These shales have lost their natural plasticity, which must be regained. This is accomplished by grinding the dry material to a powder and tempering this to the proper consistency by the use of water.

The universal method of grinding in Ohio is by the use of a large revolving pan, with two heavy iron wheels moving in this. The clay is next carefully screened to varying fineness, usually the finer the clay the finer and more durable the brick.

The value of the ware depends most of all on the *tempering;* this is accomplished at the least cost by means of

[1] Geological Survey of Ohio, vol. vii., part i. Columbus, Ohio, 1893.

the well-known pug mill. By the use of this machine the mixture is rendered very uniform.

Of all the methods used for making the bricks, the best seems to be that of moulding the clay when in stiff condition. The clays in the stiff mud machines are tempered to a plastic state; when freshly made these bricks will retain their shape under considerable weight.

The machine most generally used is the Auzer machine, consisting of a revolving screw which carries the clay forward and forces it out of the die. It combines economy of handling with a saving of steam power. The great objection is a tendency of the machine to build the bar of clay out of concentric layers, especially in a very plastic clay. By the use of shales, this difficulty has been partially removed.

Automatic cut-off tables have been devised which dispense with the slow method of hand cutting. In a recent test 250 bricks per minute were cut and removed.

Re-pressing the bricks, which was once in great favor, is found to add nothing to their value, though the method is still used.

The bricks must be carefully dried to rid them of the large amount of water used in mixing the clays. They must finally be burned so as to possess the qualities of toughness, vitrification, and uniformity.

The cost of manufacture, including loss in burning, averages about seven dollars per thousand. The cost to cities averages fourteen dollars, which will probably be greatly reduced under better financial management.

There are at present in Ohio forty-four manufactories, with 357 kilns, making annually 292,000,000 bricks.

A PLEA FOR THE STUDY OF THE PHILOSOPHY OF MATHEMATICS.

BY FRANKLIN A. BECHER, MILWAUKEE, WIS.

In early times mathematics and philosophy were kindred sciences. Mathematics was the essential study required to a preparatory entrance into the higher and more advanced branches of human knowledge. They were the complements of one another. Both set out with definite ends in view, yet the methods pursued were in some respects quite different. While the one assumed certain postulates to be true for the purpose of developing the science, the other was endeavoring to establish a principle upon which everything extant rested. The methods pursued were almost diametrically opposite. Mathematics developed in the direction from the particular to the general. It was not until the introduction of the idea of the function, by Euler, into mathematical reasoning that a more general method was possible. A philosophy of any science cannot be established until some well-defined general conceptions are developed. The philosophy of mathematics is no exception to this rule. Through the development of a more general method, the conceptions extended and became more universal; that which gave impetus to this was the introduction of the idea of the function. It was not long before the method of inquiry changed in this respect. Formerly higher algebra sought mainly to determine those values of functions for which they vanished, while modern algebra has for its problem to discover the peculiarity or nature of the function, regarding only incidentally the numeric value. The masters of modern higher algebra have gained thereby an opportunity to discover new thought-forms, which differ essentially from the old ones. These new thought-forms have aided much in suggesting many beautiful theorems and problems which again have led up to new discoveries. The progress made has been with giant strides, so that many fundamental conceptions and propositions are fast losing their validity. It is but within recent times that the conception manifoldness was introduced into mathematical reasoning by Riemann. This conception sheds light over the whole field of mathematics, and therefore has aided in establishing a foundation for a philosophy of mathematics. The essentials to a philosophy of the science are well stated by Grassmann, who says: "Since both mathematics and philosophy are sciences in the strictest sense of the terms, the methods employed in each must accordingly have something in common, which gives them their peculiar scientific character. Now, we give a scientific character to a method of treatment when the student, on the one hand, is of necessity led by it to the recognition of every single truth, and on the other hand is placed in a position wherefrom he is enabled, at every point in the development, to survey the course of further progress." Here we have the importance shown of having some central conception or conceptions, from which we can view the whole field. The men and their works that have contributed to establishing these general methods and conceptions, thereby laying a foundation for a philosophy of mathematics, are: Grassmann, in his "Ausdehnungslehre" (Hyde's Directional Calculus); Hamilton, in his "Quarternions"; Pierce, in his "Linear Associative Algebra," and Cantor, in his "Mannigfaltigkeitsrechung," the most important work from a philosophical standpoint.

Few, if any, of our universities seem to devote any time to the study of the philosophy of mathematics, and there are only a small number that embody any of the above named subjects in their curricula. In fact, it is only very recently that our modern text-book writers have deviated from the trodden path and introduced some of the more advanced notions in their works. It is only within a few months that a new and excellent treatise, the first in this country, on the "Theory of Functions," by Harkness and Morley, has appeared. Why most of our mathematical text-book writers, like lawyers, have a strong inclination to adhere to old musty forms and ways of presentation is difficult to perceive.

The importance of the study of the philosophy of mathematics is beyond all question. A knowledge merely of the objective side of any subject is not only detrimental to its presentation, but a thorough knowledge of the subject can never be obtained. It is like the bones and muscles to the human body without the nerves. Again, if these subjects are not taught which lead up to the philosophy of mathematics, so that a consistent, true and proper view can be had of the entire field of this knowledge, a teaching of this branch is fruitless. The study of all the fundamental principles of these subjects and the study of the philosophy of mathematics ought to be thoroughly mastered by every one who aspires to have an accurate knowledge of the subject and wishes to become a mathematician.

—J. B. Lippincott Company announce as an addition to their extensive list of medical books a new volume entitled "Pain," by J. Leonard Corning, A.M., M.D. The author has made a specialty of the study of this important subject, and holds that there is no department of neurology a knowledge of which is so essential to the physician.

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Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers may go directly to them. The "Exchange" column is likewise open.

THE LOCO-WEED.

BY W. THORNTON PARKER, M.D., GROVELAND, MASS.

THE locoplant is regarded by Professor Gray, of Harvard University, as the *Astragalus legum*, a peculiar species of the vetch tribe, abundant in the region of the "Texan Panhandle," and agreeable to cattle and horses, but, after having been used for some time by the latter, causing a special madness; hence its name, from the Spanish "loco." As a food its use renders horses valueless, and these seem to suffer most from this plant. It seems to have for them the fatal attraction that opium has for too many human beings. It has not yet been proved that cattle suffer very much, if at all, from this poisonous plant. Dr. J. W. Carhart, in a communication to the *New York Medical Record* concerning the symptoms and etiology of this curious affection, states that "The prominent symptoms seem to be due in part to a loss of muscular co-ordination; the horses become weak and staggering, and a slight blow on the head of an affected animal causes him to rear and fall over backwards. The animal falls away in flesh, and its coat loses its shining appearance, the hair becoming rough and of a dirty color. The brain as well as the spinal-cord would seem in certain cases to be affected, as it is stated that the animals often become absolutely crazy." The symptoms of the disease, as I have described them in a contribution to the same medical journal, agree perfectly with this description of Dr. Carhart's.

While serving in the Medical Department of the United States Army in Texas and New Mexico, I had ample opportunity to witness the poisonous effects of this plant on horses. I procured many excellent specimens, without any difficulty, and sent them to the Smithsonian and other institutions in this country and Europe. The weed does not grow as high as has been stated; it rather clings to the ground, resting upon it like a flat green mat, about the size of a small plate. Even in winter, when the grass all about is shrivelled and brown, this plant presents a bright velvety appearance, readily attracting the attention of horses and other animals, who eagerly devour it. It is very important that some investigation should be instituted, with a view of inaugurating a successful treatment for this disease. Anyone who has witnessed the actions of a locoed horse must have arrived at two conclusions; first that human beings are on account of its peculiar manifestations exposed to great bodily danger; a locoed horse without any warning starting over dangerous places or into deep water—in other words, without warning becoming unmanageable. The other conclusion is that a disease whose cause and symptoms are so obvious and well known ought to be amenable to treatment. My own observations and experiments have convinced me that the use of the muriat tincture of iron, and in fact one or two other drugs, with the accessories of hygienic treatment, will, if taken in time, act favorably upon the animals affected. "In view of the evident importance to the economical interests of that portion of the country," I think that the Government should make the necessary experiments. Referring again to my article in the *New York Medical Record*, "The symptoms of the disease, as well as the description of the plant which is the apparent cause of them, recalls the accounts given by various French and Italian writers of lathyrism. This affection presents the symptoms of a spastic paralysis of the lower extremities, the individuals having a remarkably ataxic gait. The sensibility of the skin of the lower extremities is greatly increased; there is exaggerated patellar tendon reflex, and the ankle clonus is excited by the slightest movement of flexion of the foot. The plant, to the poisonous effects of which lathyrism is attributed, is also a species of vetch, the *Lathyrus cicera*. The disease attacks chiefly men, but horses have also been known to be affected. Vision seems to be disturbed in grass staggers, but in lathyrism the eyes are unaffected. The poisonous principle of the lathyrus has not been isolated, but experiments upon animals would seem to show that it resides in the healthy plant, and not in a mildew."

Lathyrism appears to be a curable disease. It sometimes subsides spontaneously when care is taken to exclude the vetch from the diet of the patient, and its disappearance may be hastened by the administration of bromide of potassium in large doses. Revulsive applications to the spine are said also to be beneficial. Possibly a similar plan of treatment for "locoed" ponies might be followed by good results, although there would be some difficulty in weaning them from their fondness for the poisonous weed.

—At the meeting of the Chemical Society of Washington on Jan. 11, 1894, the following officers were elected: President, Dr. W. H. Seaman; Vice-Presidents, Mr. A. E. Knorr and Professor Charles E. Munroe; Treasurer, Dr. E. A. deSchweinitz; Secretary, Dr. A. C. Peale; additional members of Executive Committee, Dr. H. W. Wiley, Professor F. W. Clarke, Professor R. B. Warder and Mr. F. P. Dewey. The following papers were read: "On a Supposed Synthetic Sucrose, with Description of Process of Making," by Dr. W. D. Bigelow, and "The Differentiation of Fats," with illustrations by Dr. Thomas Taylor. The meeting of Feb. 8 was devoted to the annual address of the retiring President, Mr. F. P. Dewey, on "The Aluminium Age."

—Those who have read Dr. Charles C. Abbott's "Recent Rambles" will need no urging to take up his "Travels in a Tree-Top," shortly to appear from the Lippincott press. Whether he tells us of what he finds in the top of a tremendous oak, or of what he sees from his high perch among the leaves; whether he narrates amusing stories about corn-stalk fiddles and a Quaker grandfather, or the kitchen door of his old home in boyhood times; whether he describes for us a dinner among the Indians before Columbus "arrived," or reminds us how the bees and buckwheat of August develop into honey and buckwheat cakes for these cool mornings—he is equally genial and charming. The volume is to be printed on fine paper and in outward appearance will be both rich and dainty.

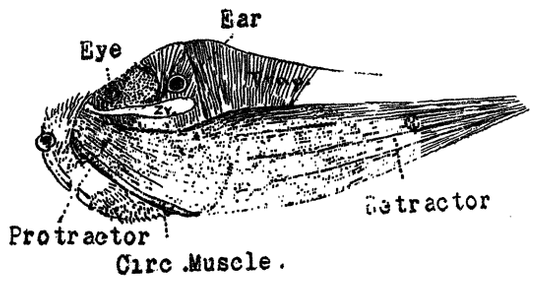
NOTES ON *GEOMYS BURSARIUS*, THE POCKET-GOPHER.

BY HENRY LESLIE OSBORN, PH.D., ST. PAUL, MINNESOTA.

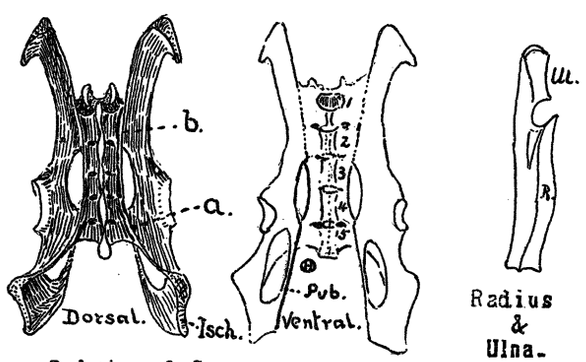
PENDING the publication of a fuller account of this interesting creature, it seems to be worth while to call the attention of students of the subject to some of the more interesting points already determined. The animal is well known in the northwestern United States, where in some regions, its habits protecting it from capture, it becomes a very great pest. In the vicinity of St. Paul, Minn., its traces are to be seen in open fields, where it can be recognized by the mounds of finely grained dirt that mark its excavating operations. It is very shy and largely nocturnal, but in more sparsely settled places it is seen in the day-time. I have never seen it in the fields that are near my home, but its mounds are common about here everywhere. The fossorial habit is thus less positive and exclusive than in the mole and in the mole-rat of Europe. Yet this animal is truly subterranean, and its structure in many interesting ways is a departure from that of ordinary rodents. In its work of digging it goes into its burrow head foremost, using the head and fore limbs nearly equally. The dirt as it is loosened is first kicked under the animal till it is collected in a mass, when the creature turns about and with the fore limbs pushes it up out of the way. The animal is thus an important agent in this vicinity in that work of the circulation of the ingredients of the soil that Darwin showed us is one of the important parts played by earth-worms in the world economy.

THE POCKETS.—The anterior part of the head of the pocket gopher is unusually elongate for a myomorph, so that the incisors are pushed out a long way in front of the molar region. This anterior region is, by reason of the great compression of the palatal region and the consequent narrowing of the roof of the mouth, well adapted for the ingrowth of the hairy portion of the upper lip, so that the latter surrounds the upper incisors, reducing the palatal area to a very narrow groove in the centre of the roof of this part of the mouth chamber. The entire roof of the mouth is covered with hair and is closed behind at the level of the molar teeth by a constriction that leaves only a circular opening at the rear closed by the short tongue. This anterior portion of the mouth may be called the vestibule, as it leads also to the pockets. It is really more external than internal, and this character is of importance in the use of the mouth as an organ of excavation. The pockets are apparently the homologue of the cheeks. They are bounded by a fold of skin on the outer side which arises from the maxillary region of the face and runs downward to the lower jaw some distance behind the bases of the lower incisor teeth.[1] Inside this fold of skin the pockets run backward to the level of the hinder border of the scapula. The pockets thus situated are lined internally with the softest hair and like the vestibule already noted are really external cavities and not a part of the mouth. The indications from a study of the pockets in other rodents, as well as from the anatomy of Geomys, are that the pockets, though thus external, are the homologues of the cheek cavities and that the clothing of hair is a secondary character.

The muscular structure of the pockets is interesting. The muscles are presumably part of the paniculus carnosus, though they are directly attached to the bony skeleton specialized for their peculiar functions. There are three distinct sets of muscles present; these are, first, a circular muscle that runs around the margin of the pocket in its outer bounding fold. This by its contraction would seem to purse the opening of the pocket. The second set of muscles are those that I will call the protractors of the pockets. These are two in number on each side. They are spread out in the skin of both the inner and outer posterior portions of the pockets, and their fibres converge forward to finally form somewhat definite bands. The outer of these is attached in the skin at the origin of the fold on the upper jaw. The other is attached to the lower attachment of the fold at the lower jaw. These two muscles thus surround the pocket, and their contraction pulls its recess forward to the opening of the vestibule. The third set of muscles are the retractors of the pocket. These arise funnel-wise from surface of the pocket both on its inner and outer aspects, and they run backward and dorsally parallel to the fibres of the latissimus dorsi and totally free from the skin. They form a band three or four inches long and nearly an inch wide and are finally inserted in the tendinous aponeurosis that covers the in-



Geomys, Muscles of the pocket.



Pelvis of Geomys.

sertion of the latissimus dorsi and is attached to the neural spines of the anterior lumbar vertebræ. These by their action retract the pockets. As to the use of the pockets, it has been erroneously thought in general among the people where the gopher is common that its pockets are used in the removal of dirt. Not a single well ascertained fact can be cited in proof of this notion, and it has been certainly ascertained that the pockets are used for the reception of the harder portions of the food which are removed in them to be stored away for winter use. The softer parts of the food are eaten and digested at the time.

THE VERTEBRAL COLUMN.—The cervical vertebræ, seven in number, are rather small, and in this way it results that

[1] See Baird, U.S.P.R.R., vol. viii., pl. xxi.

the neck region is short and the head brought nearer the shoulders. This diminution of the size of these vertebræ is not confined to any one, but is shared by them all. The second, however, has a very large neural spine. The seventh cervical vertebra is peculiar in being closely related to the first dorsal by its transverse processes, and the tubercle of the first rib articulates nearly equally with this cervical and with the first dorsal. The first rib is unusually stout, and its head is somewhat enlarged. The vertebræ of the back and loins do not call for special comment; there are twelve dorsal and seven lumbar vertebræ. It is perhaps worth while to note in passing that the lumbar vertebræ do not present any of those strong processes so noticeable in many of the rodents (as for example Lepus), but they are small and compact. The sacrals are, however, very exceptional in their character. There are five vertebræ in the sacrum. These are immovably anchylosed by their transverse processes into one piece. Their neural spines are widened and thickened at the summits so as to form a longitudinal ridge with only small openings between the spines. In the same way the laminæ of the arches are broadened and flattened to form an area sharply ridged on the margin and which posteriorly meets and anchyloses with a growth from the ischium in a manner somewhat recalling the pelvis of a bird. A somewhat similar condition is to be found in the pelvi of the two-toed sloth, *Chelopus hofmanii*. The first and second sacral vertebræ are immovably grown to the iliac bones by a surface that extends over the entire inner side of the ilium of each side, and the third sacral vertebra joins partially in the formation of this articulation. The fourth is free laterally, as is the hinder part of the third, but these are completely grown to their neighbors, both before and behind. There are seventeen caudals. These are short and stout, and the anterior ones are supplied with strong processes for the attachment of strong muscles.

THE ANTERIOR LIMB.—A stout clavicle is present. The scapula is short and broad, its coracoid portion is drawn out into an unusually long process. The spine of the scapula is very high, and the acromial process is greatly elongate and drawn out beyond the level of the glenoid cavity. (Cf. Bathyergus.) An additional strong ridge traverses the posterior border of the scapula, to which the immense triceps is attached. The humerus is short and stout, its deltoid ridge is very strong and angular, the distal end is very broad and drawn out on either side into huge areas for muscular attachment. There is no entepicondylar foramen (though one is often present in rodents)[2]. The radius and ulna are short and strongly compressed and furnished with sharp angular ridges that traverse their length. The olecranon process of the ulna is very long and strong, as is to be expected from the huge triceps already referred to. A long curving bone, "falciform," is articulated to the radial side of the wrist in addition to the pisiform bone. This is the supporting piece for the great callosity of the wrist. The metacarpals are not of equal size, the first and second being smaller and the middle one being the largest. The first row of phalanges is short, and the second row is reduced almost to a merest rudiment; the distal, ungual, phalanges, however, are large, and the middle one is largest of all. This is with reference to the production of the immense nail, which is the chief one used in the act of digging. This reduction of the proximal phalanges so as to allow a more direct pull on the terminal digit, where the chief resistance comes, is paralleled in the structures of the fore limb of cetaceans, for instance. The reduction of the neck in the gopher is also a similar case.

THE POSTERIOR LIMB.—The pelvic bone has already been partly described in speaking of the sacrum. It is so peculiar that it will require a somewhat detailed description. The accompanying drawings will help to make the matter clearer. The iliac portion of this bone is divided on its ectal surface by a very strong ridge into two parts, above and below the ridge, respectively. This ridge, furthermore, terminates anteriorly in a hook-shaped process which projects obliquely outward and backward. The ischial portion of the pelvis is drawn out into three strong processes, the most anterior of which is, as already stated, anchylosed firmly to the sides of the fifth sacral vertebra. The pubic portion of the pelvis is reduced to a narrow and very slight bone, which, instead of running inward to meet its mate and form a pubic arch, as is general in the mammalia, runs parallel or divergingly, according to the sex of the specimen. In the female there is no symphysis pubis, the two sides being widely divergent, as in birds. In the male the pelvis is much like that of the female, but there is a narrow bridge of bone across the interval between the widely parted parallel pubic bones. The appearance of this leads one to regard it rather as an ossification in tendon than any portion of the pubic bone. I have not as yet, however, had the good fortune to see any embryonic material and have no proof to offer on the homology of this structure.

The femur is not nearly so stout as the humerus. The tibia and fibula are anchylosed, as is usual in Myomorphs. The fibula is very slender. The hinder foot is small and not peculiar, the work of digging being apparently confined wholly to the anterior limb.

[2]The statement occurs in Flower and Lyddeker's "The Mammalia Living and Extinct," p. 446, as well as in the article "Mammalia," in "The Ency. Brittanica," from which the former is largely a reprint, that "in all existing forms of rodents the humerus has no entepicondylar foramen." This statement is perhaps true in general, but there are a number of cases where the foramen is normally present. I do not know of any Hystricomorphs in which the foramen is present, and it is not present in the Leporidæ, but in many of the Suromorphs and Myomorphs it is present. I have observed it in the following genera: Sciuropterus, Spermophilus, Cynomomus, Haplodon; and it is absent in Sciuras Tamias, Castor; it is present in the Myomorphs, Hesperomys, Onychomys, Zapus, Dipodomys, Cricetus, and absent in many closely allied forms, such as Mus, Fiber, Myodes, Cuniculus, Geomys, Gerbillus, Georychus, Alactaga.

AN IMPEACHMENT OF "SCHOOL BOTANY."

BY GEORGE H. HUDSON, VICE-PRINCIPAL STATE NORMAL AND TRAINING SCHOOL, PLATTSBURGH, N. Y.

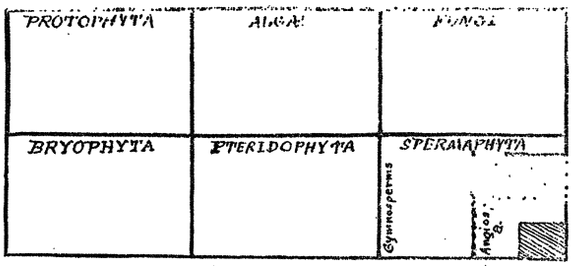
I AM in hearty sympathy with the protest in *Science* for Oct. 20, 1893, entitled "A Mistake in Teaching Botany," and for that reason cannot let the communication under the same title in *Science* of Dec. 8 pass without criticism.

To avoid confusion I wish it to be distinctly understood that the following remarks are made with reference to botany in the high school and not in the kindergarten nor in the elementary schools. Bearing this in mind, let us first take the statement of the critic, on page 318, that "There was, some years ago, a disposition to begin the study of a science at the bottom and work upward, . . . But a few years' test showed the many disadvantages of this method, and the opposite, or older, plan has been readopted." This statement is, to say the least, unfortunately expressed. I have yet to see an arithmetic that begins with cube root and works *downward* to notation and numeration, and I have yet to meet a teacher of this, the oldest of our sciences, who advocates such a course because the opposite "savors of book arithmetic." I know of neither text book nor teacher who would take a high school class in United States history, begin with the Hawaiian affair and reverse the order of events until he had traced backwards the discovery voyage of Columbus and left him petitioning for vessels to enable him to reach the East Indian Archipelago by sailing out into the unknown west; and I know of no reason why a "natural history" of the rise, progress, and condition of animal or vegetable life should take a similar course.

An interesting lesson may be drawn from the com-

parison of an old with a new text book of zoölogy. Take, for instance, Tenney's "Manual of Zoölogy," 1871, and Schiedt's "Principles of Zoölogy," 1892. Of Tenney's 535 pages of text, beginning with man, 360 are devoted to the vertebrata, and a footnote on page 533 disposes of the porifera and protozoa. In Schiedt's work of 298 pages of text the first 70 are devoted to the protozoa, and and the last 13 are all that are allowed the vertebrata. Not only do our recent text books in zoölogy follow the new order, but in all we shall find relatively more space given to the heretofore neglected lower branches of the animal kingdom.

This takes us to the matter of the representation of the field which botany should cover, and here we shall find that our "school botany" has remained so far behind the real growing science of botany as to forfeit even the right to use its title. In the vegetable kingdom, as well as in the animal, science has come to recognize a number of large and important elementary branches. Let the following diagram represent the botanical field,[1] and, remembering what school zoölogy is doing for its separate branches, note the small portion of this large field which is presented to students who imagine that they are acquiring a fair representation of the vegetal kingdom as it exists to-day:



The shaded portions of the field show that part which is thus falsely made to represent the whole. Five great branches ignored, one of the two divisions of the last branch barely mentioned, but 2 out of 7 orders of monocotyledons and about 17 out of 30 orders of dicotyledons represented, and this bit of one-sided patchwork called botany. Ten weeks spent in the study of the external structure and the analysis of fifty or more native butterflies, with the aid of French's "Butterflies of the Eastern United States," would furnish work of precisely the same value in every respect as the work usually done in school botany, but the instructor would in all probability be modest enough to call the study entomology.

The weakness of school botany by no means ends here, however. Examine the matter of classification. Groups of species are in a small part recognized, as are also groups of genera, but the relationships between families are utterly ignored. The higher groups are used as if for the express purpose of perpetuating ancient errors. The gymnosperms are still sandwiched between the allied monocotyledons and dicotyledons, and in a similar manner the choripetalæ are rudely and unnaturally split into the polypetalous and apetalous divisions and the gamopetalæ thrust in between them, the more perfectly to hide their natural relationships. Note the false position still held by the ranunculaceæ, though rightfully belonging to the compositæ, and note also the many instances in which a terminology abandoned by science is most seduously preserved.

Small as is the portion presented, and weak as is the taxonomy, still weaker is the outline and coloring with which even that small portion is presented. Here, again, we may draw an interesting lesson through another comparison of zoölogical text books. While in the older works the matter of classification is made of paramount importance, and fills the greater part of the volume, in the new English university extension manual, Thompson's "Study of Animal Life," but 63 out of 369 pages are used for this purpose, the rest being devoted to the presentation of the manifold aspects under which we may view and study the animal kingdom. This book represents the *science* of the nineteenth century. How is it with our school botany? Plant anatomy is represented by merely external features. Of plant physiology, morphology, embryology, phylogeny, geographical distribution, relation to insects, birds, mammals, man, etc., nothing is said. How fascinating is the botany of which Grant Allen gives us such charming glimpses in his "Vignettes from Nature," "Evolutionist at Large," and other sketches; how cold and repellent this usurper. Examine the average course in botany to-day and you could easily imagine yourself back in the time of Linnæus. As if Goëthe, Sprengel, Brown, von Mohl and a host of other workers were yet unborn and Charles Darwin a coming event for which the world is waiting.

Meagre and pitiable as may appear this object, which masquerades as botany, it is by no means yet seen in its nakedness. In some schools, and these by no means few in number, we shall find that "botany" has been reduced to a mere language study through which the meanings of such terms as alternate, terminal, fibrous, linear, oblong, elliptical, ovate, orbicular, obtuse, truncate, and a host of others, are learned. Gray's Lessons are studied in the winter without specimens, and the technical terms committed to memory in spite of the warning of the author himself, who says in the preface (1887), "No effort should be made to commit technical terms to memory. Any term used in describing a plant or explaining its structure can be looked up when it is wanted, and that should suffice."

The matter is really more serious than one would at first suppose. There are, it is true, certain indications which lead us to anticipate improvement. Good text books are beginning to appear. We have those of Bessey, Campbell and Spalding, which show a marked advance in the right direction; but so great is the gulf between these real text books and the limited manuals of a sectional flora, like those of Wood and Gray, that the Regents of the State of New York, basing their questions, as they do, on these manuals, practically prohibit the use of the better text books. It is true that in some places good work, of the character of that in Newell's "Outlines of Lessons in Botany," is being accomplished; and in some schools a bit of real botany is smuggled in through the use of Newell's "Botany Readers," or Hale's "Little Flower People"; but the day is ripe for a general forward movement all along the line.

It is high time that all school teachers, those studying to become teachers, and the children in our high schools as well, knew something of the bacteria, and of the millions of human beings murdered through the ignorant distribution of septic germs. Botany may be made to speak with no uncertain sound concerning the gospel of cleanliness. The compound microscope, to those who have used it, is known to be no obstacle in the way. It is high time that we gave our farmers-to-be a chance in the high school to learn something of the rusts, smuts and mildews which in some years cause the farmers of America to lose as high as a billion dollars' worth of food stuffs. There is an eminently practical side to the question, a side that is too frequently ignored.

I impeach our school botany for lack of logical order in presentation, for giving a disjointed and distorted

[1] The form more properly should have represented seven distinct branches, but for the purpose used this more common arrangement is all-sufficient.

view of the field to be covered, for using an unnatural and antiquated classification and terminology, for ignoring the fields of greatest interest which have been so wonderfully developed during the present century, and for degrading true botany to the position of a mere language study. And I also impeach the men of our nation whose intelligence and special knowledge should make them fit judges in this matter for allowing such a state of affairs to exist without the most vigorous and continued protest, and for allowing a study of such practical value and one which might be made "not inferior as a logical praxis to the study of elementary geometry"[2] to secure but a paltry ten weeks' time for its study even in a large majority of the normal schools of this State.

Let us hear from others on this subject. It is indeed time that the biologists of America awoke to the needs of the situation and did something for the pathognomonic condition of this long neglected patient. It is high time to take school botany out of the ruts of a dead past and place it where it may reflect the living science.

CURRENT NOTES ON ANTHROPOLOGY. NO. XL.

(*Edited by D. G. Brinton, M.D., LL. D., D. Sc.*)

NEW FACTS IN AFRICAN ETHNOGRAPHY.

In 1891 Dybowski was sent by the French Government into the eastern part of French Congo to punish a tribe for the murder of the traveller Crampel. He ascended to the Oubanghi, crossed an elevated plateau, and reached the head waters of streams flowing into Lake Tschad. Approaching this plateau, at about 5° north latitude, he found the dividing limit between the Bantu peoples of the south, and the tribes of the Sudan. The last tribe of the Bantu were the Bondjo, the first of the Sudanese were the Bandziri, a branch of the Niam-niam.

The contrast between these was strangely sharp. The Bondjo are extremely savage, slave dealers, and cannibals by taste, slaves being fattened for killing and their flesh sold in the open market. Nor is it dear, as one can buy a slave in good condition for the dining table for about three dollars. The Bondjo have a hideous appearance, owing to their prognathism and their custom of extracting the front teeth.

The Bandziri, on the other hand, are mild in manners, hospitable to travellers, their color a copper brown, large framed, with thin lips and good features. They are not cannibals, and live sedentary and agricultural lives.

An epitome of the results of Dybowski's journey appeared in a recent number of *Le Naturaliste*, Paris, from which these facts are taken.

THE FAR ASIATICS.

The recent work of Mr. Savage Landor on the Ainu of the northern Japanese Archipelago is exciting a certain amount of attention by the vividness of his descriptions and his ability as an artist. It is doubtful, however, if the latter faculty does not at times carry him too far. An ethnologist of repute, who has travelled among these people, writes that he never saw such hairy specimens as Landor depicts; and certainly they are exaggerated types of what the best authorities have reported.

Mr. Landor has a new theory of the aborigines of the islands in question. He believes that the Ainu, coming from the north, conquered and dispossesed an older race, the Koro-pok-kuru, who were akin to the Eskimos, and had come to Yezo from the Aleutian Islands. It is something in the way of this that the western islands of the Aleutian archipelago were uninhabited when discovered, and showed no trace of a previous population.

In this general territory, Professor Schlegel, of Leyden, continues his labor of identifying the tribes mentioned in the Chinese annals. (See *Science*, Sept. 9, 1892, and Dec. 22, 1893.) He suggests that "the people with black teeth," and those "with black legs" are the Tunguse of the lower Amoor River, who wear black seal skin boots reaching to the body. The "Land of Green Hills," where the foxes have nine tails, he thinks is Corea. A black people, north of the Ainu, referred to as "the wide-awake people," he considers to have been some branch of the Tunguse, darkened by exposure and dirt.

THE ZOREISCH INDIANS OF CALIFORNIA.

An interesting article, likely to escape the notice of American ethnologists, has been recently published on the above tribe in the publication office of the Anthropological Society of Vienna. It includes the observations of Baron von Loeffelholtz made in 1857, with additions of a later date by his son. Taken together, they present a vivid picture of the tribe, which at that date lived on Trinidad Bay, California, about 250 miles north of San Francisco, and was still in a highly primitive condition. For instance, not only were bows and arrows the usual weapons, but the arrow-heads were still manufactured of stone, the method of doing which is minutely described. The tribe was peaceable and honorable in its dealings. Much light is thrown upon its social customs. A short vocabulary is added, from which I see that it was a member of the Yurok linguistic stock. It has since been removed to a reservation and is extinct, or nearly so.

QUESTIONS IN DEMOGRAPHY.

The Eighth International Congress of Hygiene and Demography will be held at Budapest, from the first to the ninth of September next. The demographic part will especially interest the anthropologist. The secretary general, Dr. C. Muller, Rochus Hospital, Budapest, will send full particulars.

The demographic wing includes historical demography, anthropometry, presided over by the well-known scientist, Dr. Aur. Torok, demography of the agricultural classes, of towns, etc., and the statistical study of bodily and mental defects. A number of definite questions are presented for investigation and discussion under each of these headings. It is to be hoped that the United States will not be without competent representatives at this important meeting.

THE NURAGHS OF SARDINIA.

The name *nurhag* is given in Sardinia to certain ancient stone structutes, which are very abundant in parts of the island. The walls are thick, the stones laid without mortar, well fitted together. The entrance is low and leads to interior chambers enclosed with ogival arches, giving the room the shape of half an egg-shell.

The builders and the date of construction of these edifices have been a puzzle from the days of Diodorus Siculus, who mentions them then as very ancient. A writer in *La Nature*, for October, 1893, reviewing the recent evidence obtained by excavation, shows that they were built by a people acquainted with bronze, copper, tin and lead; who wore metal helmets, and used metal swords; and hence lived in the bronze age. Basing his opinion on the character of these relics and supported by some very early classical traditions, he maintains that the builders were Libyans, who came from Africa, seized a portion of the island, populated it, and constructed these solid forts as refuges and defensive works.

To this it may be objected that similar buildings have not been discovered in north Africa; but it is also true that much of the territory there is unexplored; that the Roman occupation used the material of the old buildings for new ones; and that rumors have reached travellers of extensive and ancient stone ruins in the remoter valleys of the Atlas. The theory, therefore, is not without a fair probability in its favor.

[2] "Science Teaching in the Schools," by Wm. N. Rice, p. 10, (D. C. Heath & Co.)

EARTHQUAKES IN AUSTRALASIA.—III.

BY GEORGE HOGBEN, M. A., TIMARU, NEW ZEALAND.

REFERENCE has already been made to the first report (1891) of the Seismological Committee of the A.A.A.S. (see *Science*, vol. XXI., p. 344), which, with a paper by the present writer, included summaries of all the known records of earthquakes in New Zealand to the end of the year 1890. The second and third reports of the same committee (1892 and 1893) have continued that work to the close of last year, and have added thereto similar summaries for New South Wales, Victoria, South Australia and the New Hebrides. The committee have also had placed at their disposal the observations (made under the direction of the late Captain Shortt, R.N., meteorological observer at Hobart, Tasmania) of a most remarkable series of shocks that occurred in Tasmania during the years 1883–1886. The large number of these shocks (2540) made it undesirable, if not impossible, to publish, even in a brief form, the details of each earthquake; but the chief results have been analyzed in two papers read before the last meeting of the Australasian Association; of these mention will be made below. The most interesting part of the last report (1893) is perhaps that containing the records from the New Hebrides. These consist of careful notes made by a missionary—the Rev. W. Gray—stationed at the Island of Tanna, and form the first fruit of our work in the Pacific, as distinguished from that on the continent of Australia and in New Zealand. Tanna contains one of the three active volcanoes in the group, and eruptions are frequent; nevertheless, though the volcanic and seismic phenomena are probably not unconnected, a large number of the earthquakes do not seem to have the characteristics of those commonly classed as volcanic. One feature of the earthquakes of the New Hebrides is the remarkable rise of land that has on several occasions been observed to follow the shocks. Darwin alludes, it may be remembered, to the recent elevation of these islands ("Coral Islands," chap. vi.); it is interesting to notice that they are still rising, and by no means at a slow rate. In Steel's "New Hebrides" it is stated that elevations of land took place after the earthquakes of Jan. 10, 1878, and Feb. 14, 1878, of twenty and twelve feet respectively; and further that "rocks which were formerly covered with seven or eight fathoms of water are now above high-water mark" (Steel, "New Hebrides," p. 189). The rise in the last two cases appears to have been local in nature, at least as regards the magnitude of the elevation. Here and there in books and papers upon the New Hebrides allusions less definite in character may be found to elevations of land in other islands, especially Aneityum. The Rev. W. Gray has supplied, in a letter accompanying his observations of the New Hebrides earthquakes, very definite details of elevations of land following two earthquakes, in 1888, which I believe have not before been placed on record, though they are quite as striking as the historical case noted by Darwin as having occurred on the coast of South America in 1835. On April 20, 1888, an upheaval took place at Tanna, exposing a new beach 58 yards in width. Mr. Gray says, "On examining this part I walked over ground dry-shod where a year ago I sailed in a boat and where at one time there was thirty feet of water."

The earthquake of June 24, in the same year, extended the beach another 97 yards seawards, the total width of new beach being 155 yards. Unfortunately Mr. Gray does not give the vertical height through which the coast was raised; but his description seems to imply a total upheaval for the two earthquakes of 40 feet at least. Near the middle of the beach last formed he marks a spot thus: "At this spot our mission-vessel lost an anchor more than ten years ago. It was brought up now."

The New Hebrides are cut off from the Loyalty Islands and New Caledonia by a narrow but deep trough in the ocean bed; yet some of the earth movements in these groups seem to correspond with one another. In the absence of more exact information it is premature even to hazard a conjecture; but should a sufficient correspondence be established, it would seem to show, (1) a deep-seated cause for the disturbances, (2) a general movement of that part of the floor of the Pacific Ocean. We hope to get evidence on these points shortly.

Two papers of mine read before Section A of the A.A.A.S. (Sept., 1893) dealt, the one with "Earthquake-Intensity in Australasia," the other with the "Tasmanian Earthquake of January, 1892." The former was suggested by a paper by Dr. Edward S. Holden, Director of the Lick Observatory, entitled "Earthquake-Intensity in San Francisco" (*American Journal of Science*, June, 1888). Dr. Holden gave therein the equivalents of the degrees of intensity of earthquake-shocks on the Rossi-Forel scale, in terms of the acceleration due to the velocity of the shock itself, expressed in millimetres per second; he then applied his table to form an estimate of the intensity of the shocks felt in San Francisco. I have done the same for the Australasian Colonies. For New Zealand we have for the years 1848–1892 the records of 926 earthquakes; but in the earliest years only the severest shocks were recorded, and until December, 1889, when the present system of observation through the officers of the Telegraph Department was begun, most of the shocks of intensity I. to III. on the R.-F. scale were probably neglected. Now comparatively few pass unnoticed; I have therefore taken the records for the three years, 1890–1892, only. The number of shocks is 198, and the mean average intensity per shock, as felt in New Zealand, is 72 m.m. per second, that is to say, between III. and IV. on the Rossi-Forel scale, or sufficient to make pictures move a little and to cause some doors and windows to rattle slightly.

For New South Wales (12 years) and Victoria (8 years) the average intensity is about IV.; but the records evidently omit nearly all the slighter shocks, and so this estimate is undoubtedly much too high. In South Australia, where somewhat fuller records were kept, the average intensity (10 years) is only a little over III. on the R.-F. scale.

The study of the remarkable series of earthquakes in Tasmania and southeast Australia, between April, 1883, and December, 1886, in conjunction with the determination of the origins of the principal shocks, opens up several questions of great importance, which it would take too long to discuss here. The total number of shocks for the 45 months was 2540, an average of 56.4 shocks per month, which would be sufficiently startling were it not that the average intensity of shock was only between III. and IV. (71 m.m. on the absolute scale). One month, October, 1883, enjoys the questionable distinction of having 231 shocks recorded against it, that is, seven or eight shocks a day; and November of the same year is not far behind. A second maximum of intensity was reached in August, 1884; and then a very gradual decline took place for nearly 2 1/2 years, the shocks slowly dying away at the end of 1886. The only considerable earthquake since then is that of January 27, 1892, felt all over Tasmania and in southeast Australia, for which the data were sufficient to determine the origin very nearly. It is situated below the deep trough of the Tasman Sea, about 353 miles east of Launceston and 365 miles from Hobart. The chief shocks of 1883–1886 may be referred with more or less probability to the same neighborhood; but many of the smaller shocks were more local. For 3 or 4 years a re-adjustment of the earth's crust was going on steadily; the larger shocks were perhaps merely in-

cidents caused by movements a little more rapid than usual, or by the sudden slipping of large masses out of the position of unstable equilibrium into which the slow movements had brought them. If these large or primary movements were fault movements, one would almost expect to find the axis on the edge, and not in the middle or at the bottom of a steep trough in the ocean-bed. If the primary movement, on the other hand, was principally one of revolution about the axis, interrupted by an occasional sliding of the mass on one side of the axis upon the mass on the other, then we must look for secondary movements at some distance from the axis, where the displacement caused by revolution is naturally greater. Is it possible that the lesser shocks were more or less local movements of this character? It is curious to notice that the total intensity of the series of shocks amounts to 186,690 absolute units, or about 19 times the acceleration due to gravity. The large expenditure of energy implied by this total suggests at least a possibility of a very appreciable amount of movement in the land-mass of Tasmania and southeastern Australia. Though, so far as I know, there is no evidence of elevation or depression, one does not like to think of Mother Earth wasting so much of her strength for naught.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The Editor will be glad to publish any queries consonant with the character of the journal.

Volcanic Rocks in the Keewatin.

In view of the article published in *Science*, No. 571, entitled "Volcanic Rocks in the Keewatin of Minnesota," and the very numerous recent papers on the same subject, viz.: "Archæan Volcanic Rocks," it may be interesting to your readers, and, in any case, I think it is fair to myself, to publish the following letter of mine on the same subject, which was written fourteen years ago. Any comments by me are, I think, unnecessary.

Alfred R. C. Selwyn,
Deputy Head and Director,
Geological Survey Dept., Ottawa.

"Montreal, 9 December, 1879.

"My dear Professor Dana:

"I have just read your remarks[1] in reference to what I have ventured to call the Volcanic Group of the Quebec series of Sir W. E. Logan. I should like very much to know exactly what your views on this question are, and hope at some future time to hear them from yourself personally. In the meantime I would make a few explanatory remarks on the points you refer to in my paper. You say, 'The evidence of the general volcanic origin of the second group is not stated and the kind of rocks mentioned make a remarkable assemblage to be spoken of as these volcanic rocks.' This would seem as if I had meant to assert that all the rocks mentioned as constituting the group were of volcanic origin. I might certainly have made the matter plainer had I specified those rocks in the group which there were reasons for supposing to be of volcanic origin. It never occurred to me, however, that in giving a general description of a group of strata[2] of mixed volcanic and *ordinary* sedimentary origin it would be necessary to do so. As regards the evidence of a volcanic origin, of some of them I can only say now that it is of precisely the same kind as that which, in respect of similar British strata, has been considered to be conclusive by almost every British geologist of note, including De la Beche, Lyell,[3] Murchison, Sedgwick, Jukes,[4] Scrope and a host of others now living.[5] Further, that these conclusions, first arrived at by the most careful and minute geological investigations and mapping of the stratigraphy, have been, or are supposed to be, entirely confirmed by the, comparatively recent, microscopical and chemical investigations of these same rocks.

"It is now rather more than thirty years since I took an active part, under the geologist I have first named, in working out in all their intricate details the great Lower Silurian and Cambrian and older volcanic series of north Wales. Since then I have had abundant and world-wide opportunities of studying volcanic formations of all ages, recent, Tertiary, Mesozoic and Palæozoic, and I may say that it is on the result of this world-wide geological investigation and experience, and not on the occurrence of labradorite or any other particular mineral, that I have come to the conclusion that we have in Canada, as in Great Britain and elsewhere, good evidence of the existence of volcanic strata, and consequently of volcanoes, in Silurian or Cambrian and pre-Cambrian epochs. I am quite aware that most of the peculiar rocks, which, in common with a majority of British and some American geologists, I hold to be of volcanic origin, have heretofore been generally, and doubtless quite correctly, described simply as 'crystalline,' 'metamorphic,' or 'igneous' rocks. But this, it seems to me, does not refer so much to the question of their origin, as it does to that of their present condition and character, and if we carefully study their stratigraphical relations in the field, and their microscopic and physical characters, we at once find—at least, such has been my experience—that some other explanation of their origin and associations is required besides that of their being ordinary sedimentary deposits in a metamorphic condition. Indeed, your own and Mr. Hawe's careful and admirable investigations of the chloritic formation in the New Haven region seem to me to demonstrate the entire probability, to say the least, of the igneous and volcanic origin of the rocks you describe. It is, I believe, generally admitted that rocks having the mineral and physical peculiarities characteristic of many volcanic products would be more easily affected by metamorphic agencies, especially hydration, than those which are of ordinary and unmixed sedimentary origin and that these old volcanic rocks should have assumed these metamorphic or altered characters is, of course, what might be expected and their having done so certainly does not negative the supposition of their volcanic origin. It seems to me that *à priori* probabilities of the existence of volcanoes in Eozoic and Palæozoic epochs are very strong and that those who oppose any such idea should be prepared, like those who hold the opposite opinion, to state some good reason for their views, and also the particular geological epoch when, in their opinion, volcanic outbursts first occurred. If, on the other hand, the existence of volcanoes in these early geological epochs is admitted, then we may very naturally expect to find their products associated with the ordinary sedimentary rocks of the period, in the same manner as we do those of the volcanoes of recent and Tertiary times. And this is what British geologists generally claim to have done. I have no wish to dogmatise on this question and only desire the truth, whatever that may be; but at present I cannot help feeling that if I am in error, I am so in very excellent company, and that the views of such eminent geologists as I have named, and based, as I know

[1] *American Journal of Science*, vol. xv., 1879.
[2] Now, 1891, appropriately termed "*pyroclastic*."
[3] *Vide* Lyell's "Elements of Geology," 6th ed., pp. 695, 693.
[4] *Vide* Juke's "Manual," 2nd ed., p. 324.
[5] *Vide* Ramsay, "Memoirs," Geological Survey of Great Britain, vol. iii., chap. 5.

them to have been, from intimate personal acquaintance, both with the men and with the country to which they were applied on precisely the same evidence as is to be found in Canada, are at least entitled to be regarded as something more than 'fancy sketches.'

"I am, my dear Professor Dana,

"Very truly yours,

"(signed) ALFRED R. C. SELWYN."

Inquiry Regarding Fresh-water Pearl Fisheries.

I ENCLOSE herewith a circular of queries that I am very desirous of having answered to assist in carrying out an investigation in regard to the locations, yield and proper protection of fresh-water pearl fisheries in the United States. All correspondence on this subject should be addressed to me as follows: G. F. K., care of United States Commission of Fish and Fisheries, Washington, D. C.

GEORGE F. KUNZ.

LIST OF QUESTIONS.

The pearl-bearing mussels: 1. Nature of stream in which found, kind of bottom, character of water; 2. Geological character of the district as to rock, soil, etc.; 3. General abundance of mussels; 4. Size, shape, and position of the mussel beds; 5. Local names of mussels; 6. Habits of mussels; 7. Enemies and fatalities to which mussels are exposed, nature and extent of destruction by muskrats, hogs, freshets, etc.; 8. Size, shape, and color of mussels; 9. Species of mussels in which pearls are most common; 10. Proportion of mussels in which pearls occur; 11. Sizes, or other peculiarities, of shells in which pearls are found. The pearls: 12. Nature and origin of pearls; 13. Position in mussel; 14. Size, shape, and color of pearls; 15. Relative value of pearls of different sizes, shapes, and colors; 16. Markets for pearls; 17. Prices for pearls. The fishery: 18. Method of taking the mussels; 19. Description of apparatus used in taking mussels and in opening the shells; 20. Methods of extracting the pearls; 21. Treatment of pearls when found; 22. Utilization of mussels after extraction of pearls or after opening; 23. Principal occupations of mussel fishermen; 24. Statistics of fishery in 1893: Fishermen, number; Boats, number, value; Apparatus, number, value; Pearls, number, value; 25. Statistics, complete or partial, for previous years; 26. Period when pearl fishing was of greatest importance in district; 27. History of origin and growth of fishery; 28. Exhaustion of mussel beds, causes, rapidity; 29. Do exhausted beds become replenished, and in what time? 30. Is State protection of beds desirable or necessary?

Psuedo-aurora.

THIS phenomenon has again, this winter, been of unusual beauty and brilliancy over lights in this city. The following is an explanation of the occurrence: The phenomenon is not a shadow effect, as explained by Mr. Hazen in a number of last year's *Science;* neither has it any electrical significance, as has been indicated by several writers. It has a true light effect and consists of an apparent bright shaft of light extending upwards to the zenith over bright lights. If the lights are swung high it may also be seen extending from the light to the earth. It only occurs under certain atmospheric conditions, which are about as follows: Cold, cloudless nights, with but slight wind, if any, following upon an atmospheric humidity approaching saturation. Under these conditions, small, almost solid, flat, hexagonal ice crystals fall in a constant mist, glistening in a strong light, like particles of diamond dust. It is in the peculiar flat, light form of these crystals, associated with the manner in which they fall, that explanation of the phenomenon rests.

Leaves falling from trees, during a calm, preserve, during the chief part of the descent, the horizontal position. This is found by careful observation to be alike true of the fall of the flat, hexagonal ice particles at the times when pseudo-aurora occur. The rays of light from the lamp or other brilliant light, striking the under flat surfaces of the crystals, are simply reflected to the eye of the observer; and the eye receives rays reflected from all particles of ice within the vertical plane through the eye and through the lamp or source of light, referring the grand final light effect to the vertical.

That it is not of an electrical nature is evident in that some of the most brilliant shafts occur over bonfires, and when the moon is low in the horizon, on nights showing the aurora, it is seen to cause the same phenomenon.

H. L. BOLLEY.

Fargo, North Dakota.

Notes and Queries.

Rubus strigasus is rather common in Waterbury, Conn., but I have never found it bearing perfect fruit (except as noted below). The canes are quite as strong and thrifty as any found in northern New England, and plenty of flowers are produced, but rarely more than two or three drupelets in a berry ever mature.

My observations extend over a period of more than thirty years. At present the plant is much more abundant than formerly, but the failure of the fruit to mature is the same as at first. Asking Dr. Asa Gray, at a meeting of the Botanical Section of the A.A.A.S., several years ago the cause of this, he remarked that "he should like to see the flowers" before answering.

Of course it is because they are not *fertilized*, but why are they not? Honey bees here, as further north, find the raspberry blossoms a rich source of honey, and any part they may take in the fertilizing process ought to be as effective here as in other sections. The exception to this sterility makes the sterility still more singular. Along the ditches through some of our shallow peat bogs this red raspberry grows, sometimes, very rank and tall, and it is not rare to find, in September and October, the terminal portion of the year's growth full of blossoms and perfect but unripe fruit. I have seen these berries fully grown, very large, but none quite ripe, though they probably do ripen in warm seasons. There is a cause for this failure of the summer crop, but what is it? I believe the cultivated species and varieties of the raspberry do as well here as anywhere. It is well understood that the failure of the first crop of red clover to produce many seeds is because the bumble-bees, the only insects that frequent its flowers for honey, are too few to transfer the pollen.

This cannot be the case with the raspberry. It may be found that the honey-bee, wholly intent on gathering honey, neglects the pollen altogether and that the pollen gatherers prefer that of some other flowers found here. The interrelations between plants and insects are not all yet found out, but the suggestion made above may have no foundation in fact.

Thirty years ago the farm yards and road sides in western Connecticut were white in the summer from the abundance of the flowers of the May weed (*Maruta Cotula*). A few years later—but just when no one can tell, for it passed without observation—this plant disappeared entirely. For years not a single specimen could be found. It is now slowly reappearing, but not yet abundant. Over how large a part of the country this disappearance took place I cannot say, for my observations did not extend far beyond Waterbury and the adjacent towns.

Here, as in numberless other cases, the ever-recurring *why* appears. Certainly no *apparent* cause banished this

hardy annual. This is not a solitary instance of this sort, but I do not remember to have seen any explanation of such facts. H. F. BASSETT.

Waterbury, Conn.

Chilopoda Migrating in Broad Day-light.

SEVERAL years ago a friend of the writer saw, during late summer in Nebraska, a great number of some chilopod migrating in the day-time. They were all going in one direction across a road where they were readily seen, and continued to pass over it for more than a week. A very dry spell from which the country had been suffering may have had something to do with the movements of the animals, for they disappeared after a heavy rain. The fact that they were seen in large numbers, as well as their migrating in broad day-light, is very interesting, since none of the Chilopoda are usually seen in great numbers or where there is much light. Repeated questions, however, showed that the animals were some chilopod, probably a *Scolopendra*, since they were too large for a *Lithobius* and can scarcely have been a *Scolopocryptops*.

If any reader has ever seen any of the Chilopoda migrating at any time, or in very large numbers, he will confer a favor upon the writer at least by letting him know through the columns of *Science*, or by letter, the locality, season, state of weather, duration of migration and if possible the species observed. F. C. KENYON.

College Hill, Mass.

A Miniature Water Lily.

IN reply to Prof. J. E. Todd's inquiry of Dec. 15, his Nymphaca found near Red Lake is very interesting, as it is undoubtedly *N. odorata Ait.*, var. *Minor sims.*, and the location is between that reported by J. M. Macoun from Moose River, near James Bay, in 1885, and that reported by the Natural History and Geological Survey of Minnesota, in Turtle Lake, Otter Tail Co., Minn., in 1883.

H. B. AYRES.

Corn.—A Query.

LATE last fall a friend found a peculiar ear of corn growing in his garden. He had planted ordinary sugar corn and was much surprised to find an ear each grain of which had a distinct shuck, besides the ordinary shuck on the outside. The ear is of average size, although the cob is rather small. Similar corn had been exhibited at the county fair a few years before. Is this corn going back to some earlier form? E. M. DANGLADE.

Vevay, Ind.

Rope of Maggots.

PROFESSOR WILLISTON, in his note, "An Explanation of the Rope of Maggots," remarks that the phenomenon has been but seldom observed in America, whlch leads me to give a couple of observations of my own, in Indiana. On the Campus of Purdue University is a hedge of Norway spruce, along one side of which is a drive, and on the other a walk of gravel and cinders, both raised somewhat above the level of the ground. On July 10, 1888, following a rainfall of 3 inches, vast numbers of these larvæ formed "ropes" covering a width of from one half to two inches, marching out from the hedge and following along the walk for a considerable distance, when they would return again to the hedge, crawling in ard about the latter with seemingly no especial object in view, though it was here that the maximum in width of column of march was reached. There were several separate "armies," each following an independent winding course, but separated from each other by short distances. A considerable number were placed in a breeding jar on grassy sod, where they again took up their line of march, forming a ring around the outer edge of the grassy disc. They continued to crawl around and around this edge for some time, forming a "rope" the size of one's finger.

On July 15, 1889, the day following a rainfall of 1.22 inches, I again witnessed a precisely similar phenomenon and in the exact locality on the walk where it had taken place the previous year. This appeared to me to indicate a tendency to local, permanent breeding places, the larvæ subsisting on decaying vegetation and in this case the foliage of the spruce. It would also appear that these larvæ had in each case been driven out of their quarters by the water collecting therein. F. M. WEBSTER.

Wooster, Ohio.

BOOK REVIEWS.

Pain, Pleasure and Æsthetics. By HENRY RUTGERS MARSHALL. New York, Macmillan & Co. $3.

THE object of this work is to present a theory of pain and pleasure, and from that as a basis to develop a philosophy of art. The author has evidently given a great deal of time and thought to his subject, and has made a careful study of the views of others, as well as of the psychological principles involved. Mr. Marshall begins his discussion by remarking on the difficulty of finding a word to designate both pleasure and pain, the word *feeling*, which some writers use, being, in his opinion, too varying and ambiguous in meaning, while *sensation* and *emotion* are not only ambiguous but much too narrow; hence he uses the compound word *pleasure-pain* as the only available term to cover the two kinds of phenomena in question while excluding everything else. He then proceeds to inquire what pleasures and pains in their nature are and how they are related to the other phases of consciousness. The common theory is that the states of consciousness that we call feelings, or pleasures and pains, are a distinct class of mental phenomena co-ordinate with thought and action yet inseparably connected with them. Mr. Marshall believes this to be an error, and maintains that they are *qualities* of the other states of consciousness, or, in his own words, "Pleasure-pain modes are *quales* of all mental states: qualities, one of which must, and any of which may, belong to any element of consciousness" (p. 145). This theory he supports with many arguments, accompanied by criticisms of other views, and then enters on an elaborate discussion of the physical basis of pleasure and pain, to which we can only refer our readers, as it is much too difficult and detailed to be analyzed here. We find ourselves, however, unable to accept his theory of what pleasure and pain are, notwithstanding the considerations urged in its favor. That some feeling of pleasure or pain accompanies every mental state, whether thought, sensation, volition or any other, is undoubtedly true; but we cannot bring ourselves to regard the pleasure or pain as a quality of the given state. A pleasure generally accompanies a new thought; but the pleasure seems to be a distinct phase of consciousness rather than a quality of the thought itself. Nor can we regard the feeling of compunction which often attends the doing of a wrongful act as a quality of the act or of the moral judgment that reason passes upon the act. But the subject of the feelings is so difficult that the arguments of an intelligent thinker can hardly fail to be useful, whether one agrees with his views or not.

Mr. Marshall's theory of pain and pleasure, however, is only a part of the doctrine set forth in this book; he bases on it a theory of beauty and of the aims and motives of art. "The art impulse," he thinks, "is a blind impulse which leads men to create with little or no notion

of the end they have in view"; but that the end to which this impulse really leads is the attraction of other persons by pleasing them. It follows, therefore, that a work of art is to be estimated according to the pleasure it produces, or, as the author himself expresses it: "That object is to be considered beautiful which produces a psychoris that is permanently pleasurable in revival. Each pleasure may form an element of impression in an æsthetic complex; but only those pleasures are judged to be æsthetic which (relatively speaking) are permanently pleasurable in memory. . . . We are led also to the further conclution that that object is to be considered ugly which produces a psychoris that is permanently disagreeable in revival" (p. 110). The pleasure which the beautiful object produces may be of any kind that has the quality referred to—that of being permanent in revival; and consequently men's judgments about what is beautiful will vary according to the kind of pleasure they most enjoy, or, in the author's words: "For each person the æsthetic field to which he refers in making judgments as to beauty is his relatively permanent pleasure-field of revival." From this theory it follows that the aim of the artist in his work should be to produce as great and as varied pleasures as possible unaccompanied by pain.

Now that the end at which art aims, or at least one of its ends, is what Aristotle called "noble pleasure" will be admitted by all, and the pleasures it produces are undoubtedly of the kind that Mr. Marshall refers to, but is it correct to say that all the pleasures that a work of art produces are due to its beauty? It seems to us, rather, that the pleasures produced by beauty are of a special kind, and that many of the pleasures that we experience in contemplating a work of art are due to other qualities than its beauty. A religious song, for instance, may awaken religious emotion, and a patriotic song may awaken patriotic emotion, but these pleasures appear to be quite different from that produced in both cases by the beauty of the song, and it is obviously possible to have either of the former feelings when no beautiful object is present. Mr. Marshall's art theory, however, contains much that is true and valuable, and is worthy of attention from both artists and psychologists.

A Standard Dictionary of the English Language. Vol. I., quarto. New York, Funk and Wagnalls Company.

THE preparation of this dictionary was begun nearly four years ago, and it is expected that the work will be completed by the issue of the second volume in June of the present year. The editor-in-chief is Dr. Isaac K. Funk, the head of the firm that publishes it; the managing editor is Dr. D. S. Gregory, who has also had special charge of the definitions in philosophy and theology. Professor F. A. March has had charge of the spelling and pronunciation; and there have been, besides these, several assistant editors and many writers on special topics. The dictionary, when completed, will contain two hundred and eighty thousand words, which is a much larger number than is found in any other English dictionary, the Century Dictionary having only two hundred and twenty-five thousand, and other dictionaries a still smaller number. The dictionary will be issued in two volumes of over a thousand pages each, and also in a single volume; and it seems likely to take a prominent place among the word-books of the English language.

The dictionary has certain distinguishing features, some of which, we believe, are entirely original, and are deemed by the editors decided improvements. The most prominent of these, and the one on which the most stress is laid, is the practice of giving the most common meaning

of a word first and the other meanings afterwards, without regard to logical order or historical precedence; as a consequence of which it frequently happens that some special meaning stands first and the general meaning follows. For instance, *allegiance* is first defined as "the obligation of fidelity and obedience that an individual owes to his government or sovereign, in return for the protection he receives," and then as "the obligation of fidelity in general, as to a superior or to a principle." The reason given for this arrangement is that the most common meaning is the one most frequently sought for, a proposition which as regards the ordinary words of literature we incline to doubt, as most persons who will consult such a dictionary as this are already familiar with the usual meaning of such words, and will turn to the dictionary either for some rarer meaning or to trace the etymology of the word and the logical development of its various significations. For these purposes it is obvious that the arrangement here adopted will not serve, yet experience only can determine which arrangement is better.

The editors are interested in spelling reform, and though they have not attempted to change the established orthography, they have used the alphabet devised by a committee of the American Philological Association to indicate the pronunciation of words, which purpose it serves fairly well, though some of the vowel characters are used in a way that will be strange to the merely English reader. Scientific terms have been defined by experts in the various subjects to which they relate, and we note that the editors have adopted certain changes in the spelling of chemical terms advocated by the chemical section of the American Association for the Advancement of Science. The dictionary is well printed, as, indeed, a dictionary in these times must be, and the illustrations, nearly five thousand in number, add to the usefulness and attractiveness of the work.

Domestic Science. By JAMES E. TALMAGE, D.S.D., Ph.D., F.R.M.S. Salt Lake City, Geo. Q. Cannon and Sons Co. 2nd Edit., 389 p.

THIS is an admirable little work containing a systematic review of those principles of science which we encounter constantly in our daily life. Familiarity has lead us to accept without thought the many details of household routine, but by so doing there is lost to us a vast amount of enjoyment which may be had by a clear understanding of the phenomena we see about us. The laws of nature enter into the most commonplace, and most of us would be surprised to discover how "near home" are chemistry and physics. We are only too apt to look upon these sciences as special studies for university scholars, as something apart from and foreign to our every-day life, while in reality we are constantly, as it were, at work in a laboratory applying principles of science and carrying on experiments. Dr. Talmage's work is now in its second and revised edition, having been somewhat altered to better meet the needs of students. The four main divisions are divided into chapters, the subject being treated under the general heads of air and ventilation; heating and lighting; water, its character, impurities, and purification; foods and cookery; cleansing agents; bleaching; poisons and their antidotes. It is safe to say that the students of "DomesticScience" (it has already been adopted in all the district schools of Utah) will gain a vastly greater amount of useful and permanent scientific knowledge than will those who have pursued only the customary text book course in chemistry and physics.

EXCHANGES.

[Free of charge to all, if of satisfactory character. Address, N. D. C. Hodges, 874 Broadway, New York.]

LIVING near the famous "Serpent Mound," Adams County, Ohio. I have had opportunity to make a collection of pre-historic relics. I will sell same to any one interested in archæology. Write me. Warren Cowen, Elmville, Highland County, Ohio.

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WE are engaged in a study of the geographical distribution and osteology of our North American Box Tortoises or *Terrapene* (*Cistudo*). Specimens from Georgia, Tennessee, Alabama and the Dakotas are especially desired. Material from other localities would be welcomed. Would gladly pay expressage and return specimens if desirable. Specimens should be enclosed in a small box with but little paper (without alcohol) and addressed, W. E. Taylor, Walker Museum, University of Chicago, Chicago, Ill.

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